

In the Claims

1. (Currently amended) A piezoelectric air valve to be used for a granular material sorting machine comprising:

an air valve main body including an air pressure chamber for receiving compressed air fed from an air pressure feeding means and an air outlet extending from the air pressure chamber to an exterior;

a valve body for controlling operations to open and close a space between the air pressure chamber and the air outlet;

a piezoelectric element for generating driving force required for the operations to open and close the valve body in the form of displacements;

a pair of displacement enlarging mechanisms arranged symmetrically with respect to the air outlet as upper and lower displacement enlarging mechanisms, each displacement enlarging mechanism enlarges the displacements generated by the piezoelectric element and then applies the enlarged displacements to the valve body; and

wherein the valve body, the each displacement enlarging mechanism and the piezoelectric element are mechanically connected to one another, and on one hand, the operation to open the valve body is performed in accordance with the displacements generated by the piezoelectric element and subsequently enlarged by the displacement enlarging mechanism when a voltage is applied to the piezoelectric element and, on the other hand, the operation to close the valve body is performed in accordance with resetting force of the piezoelectric element when the voltage ~~applying~~ applied to the piezoelectric element is stopped; and

wherein the upper displacement enlarging mechanism comprises:

a first hinge member, one end of which is joined to the air valve main body and operates as the fulcrum;

a second hinge member, one end of which is joined to the piezoelectric element in a substantially parallel relation with respect to the first hinge member and operates as the point of power;

a first arm member to which the respective other ends of the first and second hinge members are joined, the first arm member extending a distance longer than the distance between the first hinge member and the second hinge member, and the tip portion of which operates as the point of action; and

a first spring member, one end of which is joined to the tip portion of the first arm member and the other end of which is joined to a first part of the valve body;- and

wherein the lower displacement enlarging mechanism comprises:

a third hinge member, one end of which is joined to the air valve main body and operates as the fulcrum;

a fourth hinge member, one end of which is joined to the piezoelectric element in a substantially parallel relation with respect to the third hinge member and operates as the point of power;

a second arm member to which the respective other ends of the third and fourth hinge members are joined, the second arm member extending a distance longer than the distance between the third hinge member and the fourth hinge member, and the tip portion of which operates as the point of action; and

a second spring member, one end of which is joined to the tip portion of the second arm member and the other end of which is joined to a second part of the valve body.

2. (Currently amended) The piezoelectric air valve according to claim 1, wherein each of the pair of the displacement-enlarging mechanisms comprise:

~~a first hinge member, one end of which is joined to the air-valve main body;~~

~~a second hinge member which is substantially parallel with respect to the first hinge member, and one end of which is joined to the piezoelectric element; and~~

~~an arm member to which the respective other ends of the first and second hinge members are joined and extending a distance longer than a distance between the first hinge member and the second hinge member, and~~

~~wherein the first hinge member, the second hinge member and the arm member act as the fulcrum, the point of power and the point of action, respectively, and the displacements generated by the piezoelectric element are enlarged $L2/L1$ times at the each point of action by virtue of the principle of a pry, where a distance between the each fulcrum and the each point of power is given as $L1$ and a distance between the each fulcrum and the each point of action is given as $L2$ ($L1 < L2$).~~

3. (Currently amended) The piezoelectric air valve according to claim 2, wherein ~~the arm member includes~~ at least one of the first and second arm members include the valve body at its tip portion in a unified state.

4. (Original) The piezoelectric air valve according to claim 2, wherein the second hinge member is connected to the piezoelectric element via a cap member.

5. (Original) The piezoelectric air valve according to claim 1, wherein a valve seat is provided between the air outlet and the valve body.

Claims 6-8 (Canceled).

9. (Currently amended) The piezoelectric air valve according to claim 1, wherein the piezoelectric element, each displacement enlarging mechanism and the valve body are provided in the form of a unified unit onto a base plate separated from the air valve main body, and the unit is installed in a unit installation region in the air valve main body.

Claims 10-18 (Canceled).

19. (New) A piezoelectric air valve to be used for a granular material sorting machine comprising:

an air valve main body including an air pressure chamber for receiving compressed air fed from an air pressure feeding means and an air outlet extending from the air pressure chamber to an exterior;

a valve body for controlling operations to open and close a space between the air pressure chamber and the air outlet;

a piezoelectric element for generating driving force required for the operations to open and close the valve body in the form of displacements;

a pair of displacement enlarging mechanisms arranged symmetrically with respect to the air outlet as upper and lower displacement enlarging mechanisms, each displacement enlarging mechanism enlarges the displacements generated by the piezoelectric element and then applies the enlarged displacements to the valve body;

wherein the valve body, the displacement enlarging mechanism and the piezoelectric element are mechanically connected to one another, and on one hand, the operation to open the valve body is performed in accordance with the displacements generated by the piezoelectric element and subsequently enlarged by the displacement enlarging mechanism when a voltage is applied to the piezoelectric element and, on the other hand, the operation to close the valve body is performed in accordance with resetting force of the piezoelectric element when the voltage applied to the piezoelectric element is stopped;

wherein each displacement enlarging mechanism comprises a hinge and an arm member, the hinge is mechanically connected between the piezoelectric element and the arm member, the arm member is mechanically connected to the valve body; and

wherein the mechanical connection between the arm member and the valve body comprises a spring.

20. (New) The piezoelectric air valve according to claim 19, wherein each of the pair of the displacement enlarging mechanisms comprises:

a first hinge member, one end of which is jointed to the air valve main body;

a second hinge member which is substantially parallel with respect to the first hinge member, and one end of which is jointed to the piezoelectric element;

an arm member to which the respective other ends of the first and second hinge members are jointed and extending a distance longer than a distance between the first hinge member and the second hinge member, and

wherein the first hinge member, the second hinge member and the arm member act as the fulcrum, the point of power and the point of action, respectively, and the displacements generated by the piezoelectric element are enlarged $L2/L1$ times at the point of action by virtue of the principle of a pry, where a distance between the fulcrum and the point of power is given as $L1$ and a distance between the fulcrum and the point of action is given as $L2$ ($L1 < L2$).

21. (New) The piezoelectric air valve according to claim 20, wherein the second hinge member is connected to the piezoelectric element via a cap member.

22. (New) The piezoelectric air valve according to claim 19, wherein a valve seat is provided between the air outlet and the valve body.

23. (New) The piezoelectric air valve according to claim 19, wherein the piezoelectric element, each displacement enlarging mechanism and the valve body are provided in the form of a unified unit onto a base plate separated from the air valve main body, and the unit is installed in a unit installation region in the air valve main body.

24. (New) A piezoelectric air valve to be used for a granular material sorting machine comprising:

an air valve main body including an air pressure chamber for receiving compressed air fed from an air pressure feeding means and an air outlet extending from the air pressure chamber to an exterior;

a valve body for controlling operations to open and close a space between the air pressure chamber and the air outlet;

a piezoelectric element for generating driving force required for the operations to open and close the valve body in the form of displacements;

a pair of displacement enlarging mechanisms arranged symmetrically with respect to the air outlet as upper and lower displacement enlarging mechanisms, each displacement enlarging mechanism enlarges the displacements generated by the piezoelectric element and then applies the enlarged displacements to the valve body;

wherein the valve body, the displacement enlarging mechanism and the piezoelectric element are mechanically connected to one another, and on one hand, the operation to open the valve body is performed in accordance with the displacements generated by the piezoelectric element and subsequently enlarged by the displacement enlarging mechanism when a voltage is applied to the piezoelectric element and, on the other hand, the operation to close the valve body is performed in accordance with resetting force of the piezoelectric element when the voltage applied to the piezoelectric element is stopped;

wherein each displacement enlarging mechanism comprises a hinge and an arm member, the hinge is mechanically connected between the air valve main body and the arm member, the arm member is mechanically connected to the valve body; and

wherein the mechanical connection between the arm member and the valve body comprises a spring.

25. (New) The piezoelectric air valve according to claim 24, wherein each of the pair of the displacement enlarging mechanisms comprises:

a first hinge member, one end of which is jointed to the air valve main body;

a second hinge member which is substantially parallel with respect to the first hinge member, and one end of which is jointed to the piezoelectric element;

an arm member to which the respective other ends of the first and second hinge members are jointed and extending a distance longer than a distance between the first hinge member and the second hinge member, and

wherein the first hinge member, the second hinge member and the arm member act as the fulcrum, the point of power and the point of action, respectively, and the displacements generated by the piezoelectric element are enlarged $L2/L1$ times at the point of action by virtue of the principle of a pry, where a distance between the fulcrum and the point of power is given as $L1$ and a distance between the fulcrum and the point of action is given as $L2$ ($L1 < L2$).

26. (New) The piezoelectric air valve according to claim 25, wherein the second hinge member is connected to the piezoelectric element via a cap member.

27. (New) The piezoelectric air valve according to claim 24, wherein a valve seat is provided between the air outlet and the valve body.

28. (New) The piezoelectric air valve according to claim 24, wherein the piezoelectric element, each displacement enlarging mechanism and the valve body are provided in the form of a unified unit onto a base plate separated from the air valve main body, and the unit is installed in a unit installation region in the air valve main body.